

Impact of SciBooNE on Fermilab PPD

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Abstract

This document describes the impact that the design, assembly and installation of SciBooNE will have on Fermilab's Particle Physics Division (PPD). The document is based on a discussion session held with PPD Department heads from Mechanical Support, Electrical Engineering, Technical Centers, Site Support, Building Management, ES& H, and Neutrino Departments.

1 SciBooNE Introduction

The SciBooNE collaboration is working to bring the K2K SciBar detector to Fermilab, and install it as a near detector in the Booster neutrino beamline (BNB), which has been providing neutrinos to the MiniBooNE detector since late 2002. SciBooNE offers a broad neutrino scattering program, complementing the existing and planned neutrino experiments at Fermilab.

SciBar became available for use in other neutrino beam lines after K2K beam operations were terminated in 2005. This document highlights the labor and materials costs that PPD would have to supply to install the SciBar detector in the BNB at Fermilab.

The labor and cost estimates in this document come from the heads of the various departments. Tasks that must be completed in specific locations, and existing materials that must be used, have been discussed with the department heads, or owners of the materials in question, and informal agreements for use of the spaces or materials exist.

1.1 Outline of SciBooNE Construction and Installation

The following describes the process of bringing SciBar to the U.S. and installing it in the BNB, emphasizing the impacts on PPD. There are three sub-detectors in SciBooNE: SciBar, the electron catcher (EC) and the muon range detector (MRD). SciBar and the EC will be shipped from KEK, whereas the MRD will be assembled at Fermilab using materials from past fixed target experiments, primarily E-605. The civil construction for an enclosure in the BNB, shipping and assembly of detectors at Fermilab, and construction and assembly of the MRD will take about nine months.

KEK is now in the process of disassembling SciBar. The PMTs have been dismounted and the wavelength shifting fibers have been removed and stored. In the next few months, the detector planes will be disassembled and packed for shipping. If

feasible, it would be beneficial for two technicians to be sent to Japan to understand the disassembly procedures. However, this is not a requirement for the success of the experiment.

While civil construction for the detector enclosure is going on, reconstruction of SciBar and the EC will take place in the MINOS near detector surface building (MSB). Most of these tasks will be completed by the Mechanical Engineering Department. Reassembly of SciBar at Fermilab includes installing the scintillator into the frame to reconstruct the SciBar detector and installation of the fibers, PMTs, and front-end electronics; all these tasks would be overseen by the techs who learned about the disassembly in Japan. If FNAL techs are not able to go to Japan, then it will be crucial for two techs to be involved and educated by the Japanese techs who come to Fermilab with the SciBar detector.

Most of the materials needed for the MRD have already been identified, and their assembly could be done before the arrival of the detector from KEK. The iron plates and scintillators have been identified and reserved for SciBooNE, as well as the majority of the PMTs needed for the MRD. PREP has in stock the necessary electronics. What remains to be found or built are the light guides to connect the scintillators to the PMTs. Most of this development will be done by the Tech Centers Department. A frame to hold the MRD components must also be designed and built. A mechanical engineer is already working on the design of the frame.

The critical path for occupancy in the beam will be the construction of the detector enclosure. A design study has already been carried out by FESS and PPD engineers to derive a cost estimate and schedule for the detector enclosure. The construction schedule of the detector enclosure requires about nine months between approval and beneficial occupancy. The bulk of this work falls outside the responsibility of PPD, except for oversight from ES&H.

2 Design Tasks

The frame to hold the iron plates and scintillators for the MRD must be designed. This frame must also support the light guides and PMTs for the MRD. For this design, one mechanical engineer will require three full time months of work. Additionally, five full months of a mechanical designer's time are required to document and make the drawings for the MRD frame. These tasks are detailed in Table 1, which describes the impact on Mechanical Department.

The other major design task is the light guides for the MRD. The current working design idea is the so called black-bar-with-fiber-connections design. To fully develop this design, one designer will require one full month of work. This time estimate includes prototyping. These tasks are detailed in Table 2, which lists the impact on Tech Centers.

Task	Labor Type	Time	M&S Costs
Understand general layout; Design frame, plate stacking fixture & lifting fixtures; Write up JHA's	Mechanical Engineer	0.25 FTE total (3 man-months: Dec, 2005 - Feb, 2006)	N/A
Build MRD frame	Mechanical Tech	0.1 FTE total (1 man-month: April, 2006)	\$10,000
Document and make drawings for engineer and project	Mechanical Designer	0.4 FTE total (5 man-months: Dec, 2005 - April, 2006)	N/A
Understand detector assembly & disassembly; help with disassembly at KEK; reassembly at FNAL; installation at FNAL	Mechanical Technician	0.7 FTE total (2×4 man-months: Jan/Feb, 2006 and June-August, 2006)	\$5,000 (travel)
Disassembly	Mechanical Engineer Engineer	0.3 FTE total (2×2 man-months, c.2008)	N/A
Totals		1.75 FTE total	\$15,000

Table 1: *SciBooNE labor requirements from Mechanical Engineering. These figures include 40% contingency estimates. The FTE figures are normalized to full time effort for one year.*

3 Fabrication Tasks

The main fabrication task is the construction of 250 bars and the corresponding “cookies” for the light guides for the MRD. For this, one technician, who must be a CNC operator, is required full time for two to four weeks, and another technician will be required half time for six months to oversee the polishing, gluing and wrapping procedures. These tasks are detailed in Table 2. For M&S, the fabrication requires approximately \$1,000 for cutters for all tasks, and \$1,000 for epoxies, tape, etc. These materials costs do not include the cost of the optical fibers and cookies themselves, which are expected to cost approximately \$50,000. These fabrication procedures also require enough space to perform the tasks; most likely this would be done in Lab 6.

The frame to hold the MRD must also be built, by Mechanical Department techs. This is expected to require one FTE for 1 month and approximately \$10,000 in M&S.

4 Installation Tasks

Two Mechanical Department technicians (0.7 FTE total for both) for the installation. This includes the time to go to KEK and learn the SciBar disassembly and assembly procedures. This is detailed in Table 1. Tech support is also required from the Site Department for assembly support at MSB (0.1 FTE), pulling cables (0.1 FTE),

Task	Labor Type	Time	M&S Costs
Design & CNC programming of bar and cookie	Designer	0.1 FTE total (1 man-month, Feb, 2006)	\$1,000
Construct 250 bars and cookies	Technician (CNC operator)	0.05-0.1 FTE total (2-4 man-weeks, March, 2006)	~\$20-50,000
Polish bar & cookie ends, Glue or oversee gluing and wrapping of counters	Technician	0.25 FTE total (1/2 FTE for 6 months April-September, 2006)	\$1,000
Totals		0.45 FTE total	\$22-52,000

Table 2: *SciBooNE labor requirements from Tech Centers, assuming black-bar-with-fiber-connection design. These numbers include a 20% contingency estimate. The FTE figures are normalized to full time effort for one year. The cost of the materials for the optical bars and cookies (\$20-50,000) might be able to be covered by one or more of the university groups.*

AC power distribution (0.1 FTE), rigging (0.1 FTE), and general tech support at installation (0.25 FTE). The impact on Site Department is detailed in Table 3, which also shows the associated M&S costs for the Site Department tasks. The total M&S cost for installation is \$36,000.

Installation also requires use of MSB for approximately 3 months.

5 Decomissioning and Disassembly Tasks

Two mechanical technicians are required full time for two months each for the disassembly tasks. Disassembly may require use of MSB, or a similar space, for a period of approximately one month. Note that the detector can also be removed and stored as a unit if that becomes appropriate.

6 Oversight

ES&H oversight will be required in the design phases and for the installation procedures. This includes inspection of the environmental impact statement.

7 Summary

The personnel requirements described above are listed along with a brief description of the tasks to be performed by each in the tables throughout this document, organized by departments. The personnel totals from PPD are 0.45 FTE from Tech Centers, 1.75 FTE from Mechanical Department, and 0.65 FTE from Site Department, and something on the order of 0.05 FTE from ES&H. SciBooNE also requires

Task	FNAL Labor Type	Time	M&S Costs
support for assembly at MSB	Tech	0.1 FTE total (1 FTE, June 2006)	\$3,000
Pull communication cables and fibers	Electrical Tech	0.1 FTE total (1 FTE, July 2006)	\$4,200 (cable pulls) \$6,000 (purchase)
AC power distribution	Electrical Tech	0.1 FTE total (1 FTE, July, 2006)	\$12,000
Rigging	Tech	0.1 FTE total (1 FTE, August/ September 2006)	\$18,000
General tech support at installtion	Tech	0.25 FTE	N/A
Totals		0.65 FTE	\$43,200

Table 3: *SciBooNE labor requirements from Site Department, with associated M&S costs including a 20% contingency. The FTE figures are normalized to full time effort for one year.*

\$43,200 in M&S from Site Department, \$15,000 in M&S for Mechaincal Department, \$2,000 in M&S from Tech Centers, and between \$20,000 and \$50,000 for optical fibers and cookies.

Task	Labor Type	Time
Inspect and understand all procedures; assess safety hazards	Safety Officer	0.05 FTE

Table 4: *SciBooNE requirements from ES&H. The FTE figures are normalized to full time effort for one year.*